National Weather Service Des Moines' Newsletter

THE WEATHER WHISPER

Volume 5 Issue 3 **Winter 2011**

The 100 Year Anniversary of the "Great Blue Norther" on 11/11/11 *by Jim Lee, General Forecaster*

On November 11, 1911, a very strong cold front produced unprecedented temperature falls across most of the central U.S. as well as widespread damaging winds and severe thunderstorms. A large area of low pressure, stretching from Wisconsin southwest across Iowa and into Kansas, had been nearly stationary for a couple of days allowing a long cold front to sharpen across the region as warm air was pumped up ahead of the system, and unseasonably cold air flowed in behind it. On the 11th the low pressure center and cold front advanced across southeastern Iowa and the rest of the Midwest, reaching the Ohio River Valley by sunset.

The passage of this cold front was historic for the rapidity of temperature falls behind it. Most of Iowa was already behind the front on the 11th so temperatures never warmed substantially. However, in the southeast, abundant sunshine and southerly breezes ahead of the front brought temperatures

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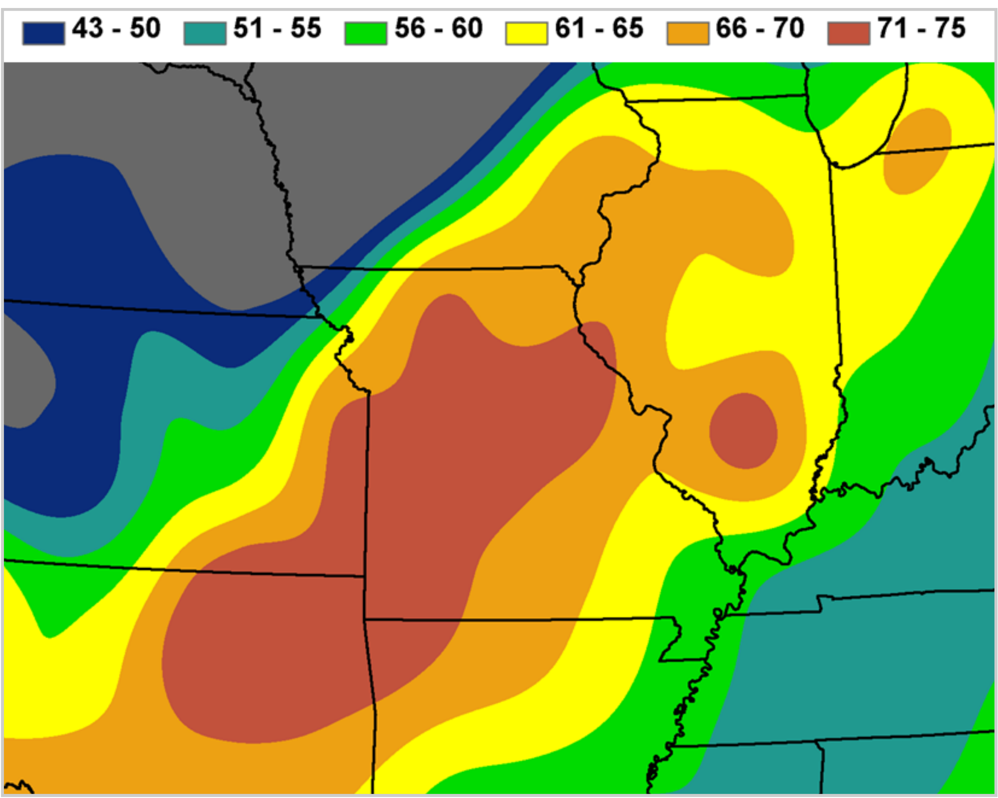

Magnitude of temperature falls associated with the Great Blue Norther. The contours represent the difference between the high temperature before frontal passage and the low the following morning. In southeastern Iowa temperatures fell by 66-70 degrees in 18 hours or less.

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Editors

Ken Podrazik
Aubry Bhattarai

Cover photo courtesy of Brenda Brock

"Great Blue Norther"

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up into the 70s before midday. Between about noon and 2:00 pm the front swept through that corner of the state with rain showers changing to sleet and then snow. At Albia the temperature rose to 72°F by late morning, then the front moved through and blizzard conditions were reported in the afternoon as the temperature fell to 5°F by 9:00 pm, making a drop of 67°F in less than 12 hours. At Keokuk the temperature peaked at 79°F just after noon, then as the front moved through it fell by 37°F in one hour and reached 14°F at midnight with an inch of sleet falling in the evening. The high temperature at Keokuk the following day was only 17°F.

Further south and east temperature falls were even more pronounced across parts of Illinois, Missouri, and Oklahoma. At Oklahoma City, OK and Springfield, MO the daily record high *and* low temperatures for November 11 were both set in 1911 and have been unmatched in the 100 years since. At Springfield the temperature reached 80°F at just after 3:00 pm, then the front moved through at 3:45 pm and the temperature fell by nearly 40°F in just 15 minutes, then to 21°F at 7:00 pm and 13°F at midnight. Winds gusted to as high as 74 mph behind the front while reports of rain, hail, sleet and snow all occurred within a period of less than two hours.

Across parts of Wisconsin, Illinois, Indiana, and Michigan the passage of the front was accompanied by severe thunderstorms and tornadoes. Several tornadoes produced F3 or F4 damage with fatalities as far north as Wisconsin. A weaker tornado was also observed just west and northwest of Davenport. Strong winds behind the front resulted in numerous injuries and widespread damage to farm buildings, trees, windmills, utility lines, etc. In Chicago a man died from heat stroke on November 11, then two people froze to death the following day. Many of the records set during the Great Blue Norther of 1911 have not been equaled in a century, and those who experienced it remembered that day for the rest of their lives.

Winter Weather Word Search

R	V	N	I	U	O	B	P	T	L	W	C	O	A	O	W	U	M	V	C
N	C	E	M	I	R	Y	Y	V	S	O	O	L	H	K	P	S	Z	I	K
E	T	I	B	T	S	O	R	F	L	O	B	N	T	G	Q	T	W	S	U
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N	O	I	T	A	L	U	M	U	C	C	A	N	R	O	P	H	I	T	C
Z	C	L	J	I	C	S	T	C	W	D	C	E	I	P	R	X	W	Y	D
S	V	A	P	Z	L	N	W	F	S	Q	H	W	T	Z	F	M	O	J	N
H	N	P	T	E	K	E	Z	R	V	T	U	R	F	S	E	V	L	R	I
C	E	O	E	N	F	E	D	S	O	P	H	J	F	G	D	E	B	T	W
R	D	T	W	S	J	R	D	P	F	L	U	R	R	I	E	S	R	Y	U
C	M	S	H	S	A	G	Y	E	J	K	A	C	O	H	T	W	B	F	E
D	C	K	B	Z	Q	H	W	I	N	T	E	R	S	T	O	R	M	C	Q
V	T	A	Z	U	S	U	K	M	O	I	E	O	T	C	N	O	W	J	R
M	G	I	D	U	Z	I	A	E	W	D	X	T	Q	X	S	D	G	S	K
W	L	S	V	Z	R	Z	H	L	C	C	U	Z	Y	C	M	Y	F	D	E
B	X	L	E	B	G	L	I	G	L	X	D	M	K	W	M	G	A	O	V

Click here for a printable image of the Word Search

Answer key on page 10

Fun Fact: Iowa possesses the oldest continuously operating state weather program in the nation. The Iowa Weather Service was founded on October 1, 1875 by Professor Gustavus Hinrichs at the University of Iowa.

Word Bank
accumulation
Alberta Clipper
blizzard
blowing snow
cold front
flurries
freezing rain
frost
frost bite
hoar frost
hypothermia
ice storm
rime
sleet
snow
snow squall
visibility
wind chill
winter storm

New Flood Inundation Mapping Tool *By Jeff Zogg, Senior Service Hydrologist*

Partner and user feedback to the National Weather Service (NWS) concerning its flood-related warnings and forecasts has been unanimous in requesting flood inundation information in a graphical format. Such information would help emergency management officials plan evacuation areas and protect critical infrastructure. Although our partners and users do find some value in our flood impact statements, our partners and users stated they would find significantly more value in maps showing the expected extent of flood-related inundation. Here's an example of a flood impact statement: *At 15 feet, the lowest sections of the River Road are flooded between 5th Avenue and Main Street.*

The NWS has a national-level flood inundation mapping program as part of its Advanced Hydrologic Prediction Service (AHPS). This program leverages the resources of multiple partners including the U.S. Geological Survey, the U.S. Army Corps of Engineers and the Iowa Flood Center at the University of Iowa. The resulting maps are developed using a sophisticated hydraulic model. Unfortunately, a significant amount of time and money is required to develop and implement inundation maps. A recent example is the Iowa River at Iowa City, Iowa. Inundation mapping efforts began for that location in late 2008. The inundation maps were completed in the summer of 2011.

In 2010, collaboration activities between NWS Des Moines and Iowa State University yielded an inundation mapping tool that can be run locally at NWS Des Moines. The correct use of this tool requires considerable knowledge of both Geographic Information Systems (GIS) and hydrology. Using this tool, a complete library of inundation maps can be made for a given location in as little as one or two days. In addition, there is no additional cost to the NWS, its partners or you—the taxpayer—for making them, as this local inundation mapping tool utilizes computers and software already in place at NWS Des Moines.

NWS Des Moines has used this tool to develop flood inundation map libraries for selected locations in the NWS Des Moines service area which have experienced high-end flooding over the past couple of years. These locations include Squaw Creek in the Ames area as well as Fourmile Creek and Walnut Creek in the Des Moines area. Figure 1 shows the expected inundation from August 2010 near-record high crest on Squaw Creek in Ames.

Presently, NWS Des Moines is working with its emergency management partners to evaluate the accuracy of this tool. The tool's inundation maps are being compared to actual flood inundation from past events to determine where the tool did well and where it did not do well. Although this tool has some limitations, initial results are encouraging. At many locations, the tool's inundation maps closely approximate the actual inundation. It appears as if this tool will add value to NWS Des Moines flood warning and forecasting services.

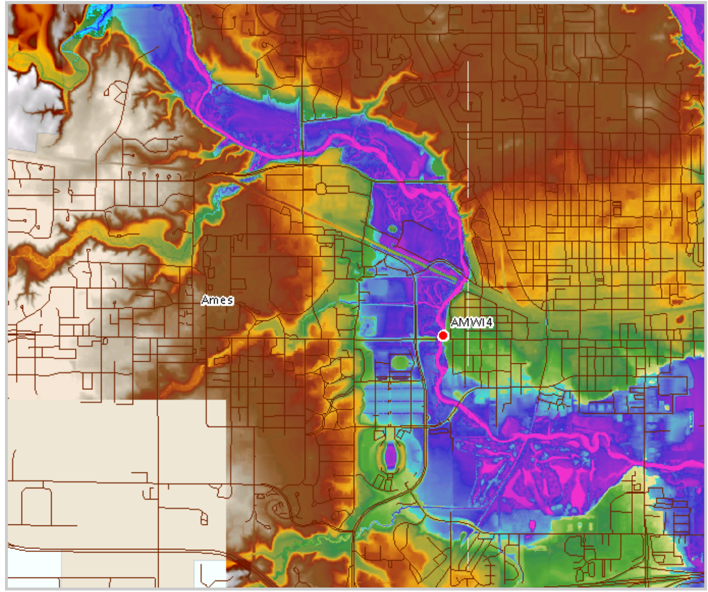


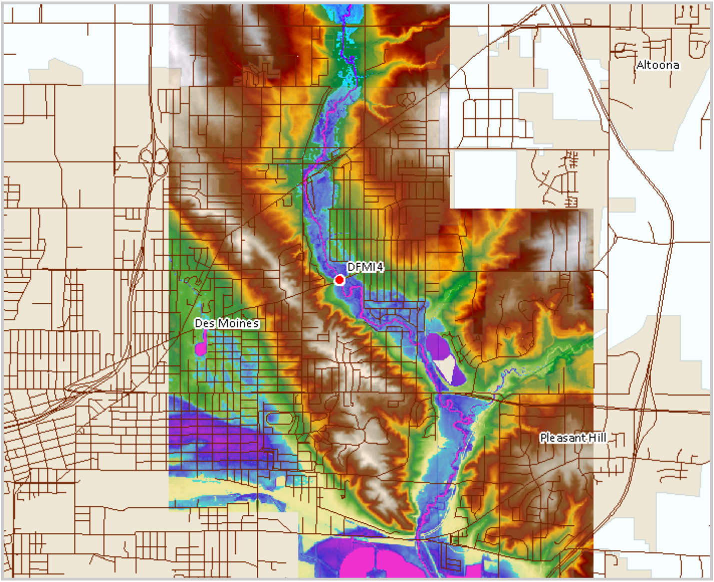
Figure 1: An example of the NWS Des Moines flood inundation mapping tool at work. It shows the expected inundation from the Squaw Creek in portions of Ames from the August 2010 event. Blue and purple colors show the inundated areas. The Iowa State University campus is in the upper left portion of the map, and the US Highway 30 / South Duff Avenue interchange is at the lower right. Lincoln Way runs from the left middle to right middle portion of the map.

Where do we go from here? Once it is determined that the NWS Des Moines flood inundation mapping tool produces accurate results, the maps will be generated and provided to emergency management officials as time and resources allow. NWS Des Moines will also pursue ways to put these maps on its public Web site.

One final note: The flood inundation maps developed by the NWS Des Moines tool are not intended to compete with those generated by the aforementioned NWS national-level program. Rather, they are intended to be complementary. Since considerable time and money is required to develop and implement the national-level program maps, the maps generated using the NWS Des Moines tool are intended to provide flood inundation maps until the national-level maps arrive. There is no timetable for the development and implementation of the national-level maps efforts because those efforts largely depend on funding availability.

August 2010 flooding from Squaw Creek affects portions of Iowa State University and Ames. Jack Trice Stadium—home to Iowa State University football—is in the foreground. Photo courtesy of the Des Moines Register.

Flood Inundation Mapping



Output from the NWS Des Moines flood inundation mapping tool for Fourmile Creek in the Des Moines area. It shows the expected inundation from the August 2010 flood event. Blue and purple colors show the inundated areas. The eastern edge of the Iowa Capitol Complex is at the far lower left portion of the map, outside the shaded region. The U.S. Highway 65/69 bypass is on the far right side of the map.

Related Web sites:

NWS/AHPS flood inundation maps—general Web page: http://water.weather.gov/ahps/inundation.php

NWS/AHPS flood inundation maps—Iowa River at Iowa City, Iowa: http://water.weather.gov/ahps2/inundation/inundation.php?gage=iowi4

Employee Spotlight

Darren Snively, SCEP (Student Career Experience Program)

I am from Vandalia, Ohio, which is a suburb of Dayton. I received my B.S. in Geography-Meteorology from Ohio University (in Athens) in June 2010, and I am now in my second year of graduate school at Iowa State University. My research deals with the WRF (Weather Research & Forecasting) model and how it simulates convective morphology and precipitation totals. I started my SCEP work this summer at the National Weather Service in Wilmington, OH, where I worked with the upper air program as well as some severe weather coverage. Being from southwest Ohio, I am an avid Reds fan, and I root for the Buckeyes during college sports seasons (Ohio U's Bobcats really aren't on TV). I also enjoy spending time outdoors by grilling, (tent) camping, hiking, and canoeing. My fiancée followed me here to Iowa, and I have a cat named Oscar.

Employee Spotlight

Rachel Hatteberg, SCEP (Student Career Experience Program)

As a SCEP, I am concurrently working at the National Weather Service in Johnston as well as finishing my Masters of Science degree in Meteorology at Iowa State University. I've been in this position for just over a year and have loved every minute of it thus far. My research interests involve regional climate models and their capabilities of simulating extreme wind events in the Midwest. I have also been investigating near-surface wind speed trends with various climate change scenarios.

I am from a northern suburb of Minneapolis, MN, raised in a small family with one older sister. I earned my undergraduate degree at Iowa State University in the spring of 2010. In my free time, I enjoy distance running, camping in northern Wisconsin, playing tennis, cake decorating, and as of late, learning ballet. I've completed four marathons and three half marathons so far, and plan to continue entering in the races until I am too old to run! I have two adopted cats, Tootie, who I've been told looks like a ferocious gray lion, and KC, which stands for "Kitty Cat."

I love every aspect of Midwest weather, there's nothing like camping on hot summer days and then sledding atop the heaping mounds of snow in the winter.

Outlook for November and the Winter of 2011-2012

by Miles Schumacher, Senior Forecaster

The warm weather this past summer was stronger than is typically the case with second year La Niña patterns. The transition into fall began by mid August, with September turning out to be a cooler than normal month. That turned around in October, with warmer than normal conditions prevailing. The overall dry conditions that settled into the state this past summer lingered into the fall, which is consistent with the return of a La Niña pattern.

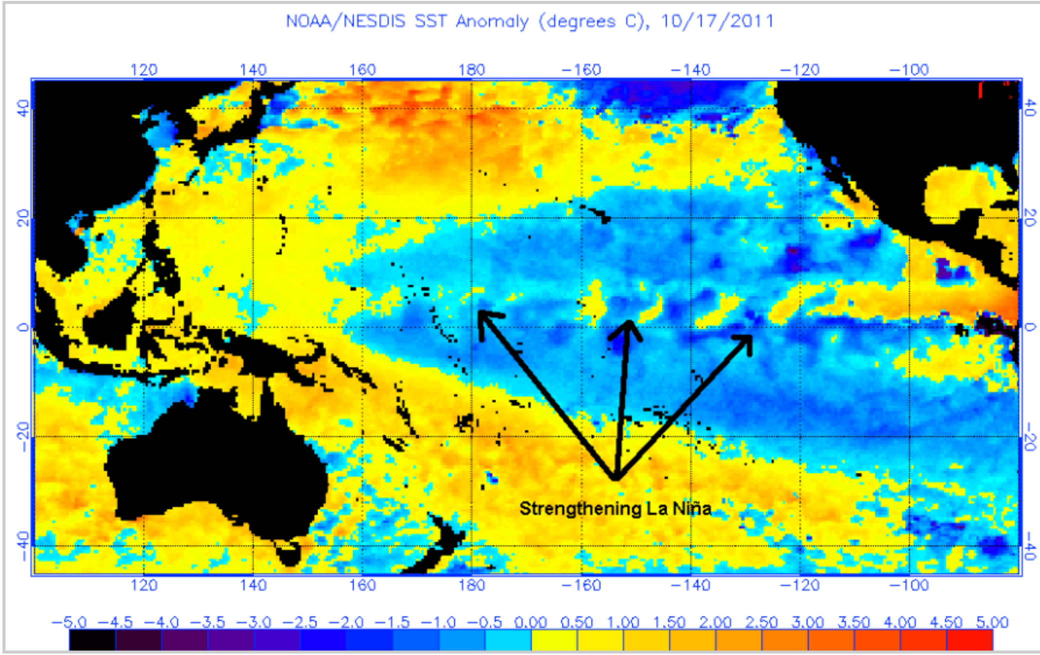


Figure 1: Sea Surface temperature departure from normal, equatorial Pacific.

Although La Niña had weakened during the early summer, the Pacific Decadal Oscillation (PDO) in the Pacific Ocean remained in a negative, or cold, phase. The characteristics of a negative PDO include water that is generally cooler than normal around the edges of the basin, with a warm pool in the central Pacific. This configuration favors the development of La Niña conditions, or cool water along the equatorial Pacific by 2 to 1 margin over El Niño, or warm conditions. The current temperature departures for the equatorial Pacific are shown in Figure 1. Note that generally cooler than normal water extends nearly all the way across the Pacific. Also, the "horseshoe" patter of warm water around the area of relatively cool water is a classic La Niña signature.

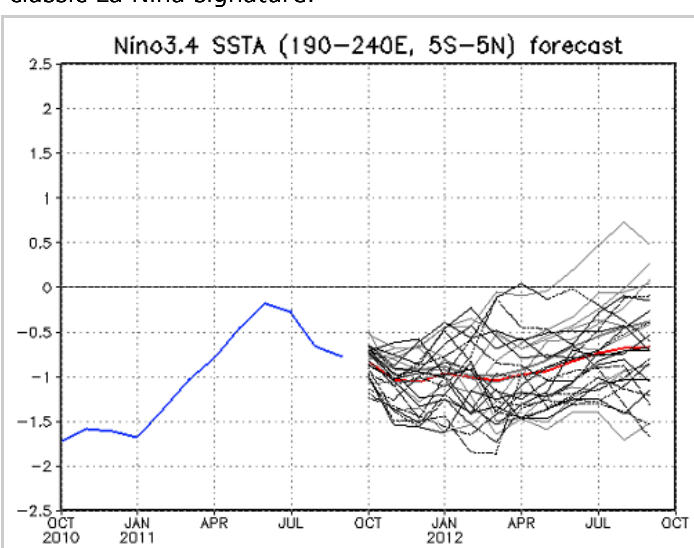


Figure 2: Sea Surface temperature departure for the past year and projection into the Fall of 2012. Departure in Kelvin (K) is shown on the ordinate, with time on the abscissa. Chart from the Frontier Research Center, JAMSTEC.

The atmosphere typically follows a 3 to 7 year cycle between El Niño and La Niña. Depending on the phase of the PDO, El Niño/La Niña is favored during warm/cold phase of the PDO. It is quite common during the cold phase of PDO for La Niña to return in a weaker form for a second winter season. In fact, during the cold phase of PDO, the La Niña pattern persists for an average length of 21 months. We saw this occur most recently during the last La Niña event where a La Niña in the winter of 2007-08 was followed by a weaker one in the winter of 2008-09. Model forecasts suggest La Niña will remain weak to moderate in strength this winter. It is likely to persist into the spring of 2012 and not return to near neutral conditions until the winter of 2012-13. It is too early to tell if we will see a third La Niña winter next year, but during cold PDO it is not unheard of. Examples during the last cold phase include 1949-51, 1954-56, and 1973-75. Figure 2 shows the central Pacific sea surface temperature departure (blue line) and a series of forecasts (black and grey lines) and mean forecast (red line) through the time period based on the initial conditions from 1 October 2011. As can be seen from the figure, there is a significant spread in the forecasts from the early fall months forward; however, most of the runs are showing at least a weak La Niña. It should be noted that this forecast is based on one model only. This model suggests a stronger La Niña signal than the overall average, but most of the 25 models used suggest a weak to moderate La Niña through next summer. The influence of La Niña is much weaker in the summer and fall than during the winter months.

Although in meteorology no two years are the same strictly speaking, one can look at weather patterns of

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Winter Outlook

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the recent past to give some indications of near term weather trends in the future. This forecast is based in large part on the best fit from several of the years that were similar to the late summer and early fall pattern so far. Considerations were also made for the state of La Niña and other factors that influence our weather pattern.

For the month of November, it appears the overall warm signal that became established in October will persist well into November. There are indications there will be a change to a colder pattern late in the month. Unfortunately, for the sake of soil moisture recharge, the weather pattern will remain favorable for drier than normal conditions for the month of November. See Figures 3 and 4.

With the likelihood of a weak to moderate La Niña through the winter, we will also see the influence of that on our winter weather. The La Niña is expected to be weaker this year than last year. Typically there is more variability in the weather pattern with a weaker signal. There are two other factors that will have influence on the weather pattern. One is the negative PDO in the Pacific, the other the current warm phase of the Atlantic Mulidecadal Oscillation (AMO) in the Atlantic. Without going into a long dissertation of these oscillations, it is important to note that they do have influence on the weather in Iowa. For the winter of 2011-12 it appears temperatures in Iowa will average cooler than normal. Note, this is based on the 1981-2010 normal, which is about 2 degrees warmer than the old normal used last year. Given the factors mentioned above, statistical odds favor the coldest part of the winter occuring during the first half, with some moderation by later in January and February. Precipitation is likely to average close to normal for the winter with above normal over northeast Iowa and areas northeast, drier than normal conditions over southwest Iowa and areas southwest. See Figure 4 for details.

These outlooks are based more heavily on statistics than many of the methods used by the [Climate Prediction Center](). The complete set of official forecasts from the Climate Prediction Center can be found on our [website]().

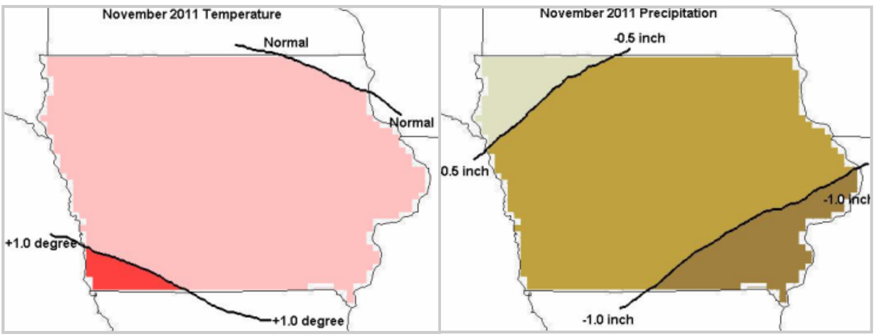

Figure 3: Mean Temperature (left) and Precipitation (right) departure for November.

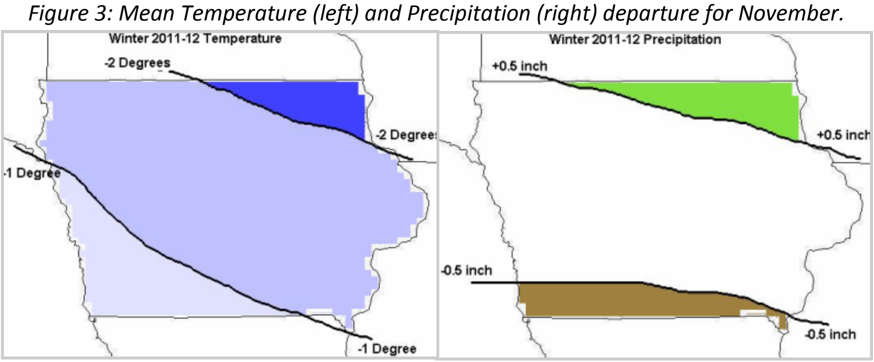

Figure 4: Mean Temperature (left), precipitation (right) departure forecast for Winter 2011-12.

Office Outreach *by Jeff Johnson, Warning Coordination Meteorologist*

Jeff Johnson and Rob DeRoy of the NWS at the Prepare Fair

The Central Chapter of Safeguard Iowa Partnership hosted its first annual Prepare Fair on October 8, 2011 at Capital Square in downtown Des Moines, IA. The Prepare Fair brought together more than 20 organizations that play a role in disaster preparedness, response and recovery. Emergency management agencies and public and private entities educated the public about how to make a safety kit, formulate a plan and be informed.

The National Weather Service (NWS) booth contained information about NOAA Weather Radio, different ways to receive weather information and weather history birthday certificates.

On November 5, 2011 the NWS in Des Moines, IA hosted a Boys Scout Weather Merit Badge day at the NWS office in Johnston. Over 60 boy scouts earned their weather merit badges at the event.

The scouts learned about a variety of weather information, were given a tour of the NWS office along with tasks in order to complete their merit badges.

Boy Scouts and NWS staff working on Weather Merit Badges.

Heat Bursts Bake Southwest Iowa

by Kevin Skow, Meteorologist Intern

During the evening of August 23, 2011, a series of rare phenomena known as heat bursts affected portions of southwest Iowa. Heat bursts are generated by dissipating thunderstorms and are characterized by a sudden rise in temperature, a drop in humidity, and strong winds that can approach or exceed that of a severe thunderstorm. Many locations in southwest Iowa recorded temperature increases of 10 to 15 degrees in just a few minutes, with the temperature at two sites exceeding 100 degrees.

So what is a heat burst and why don't all dying thunderstorms produce them? While heat bursts are not fully understood, we do know that it takes a combination of a decaying thunderstorm and a very dry layer of air beneath the base of the storm to generate a heat burst. Figure 1 shows the upper air sounding from Omaha, Nebraska at 7:00pm CDT on August 23 and clearly depicts this dry layer (circled), or a large spread between the temperature (red line) and dew point (green line) from the surface to roughly 18,000 feet.

A decaying thunderstorm is needed for two reasons. First, as a thunderstorm weakens, the lower portion of the storm typically dissipates and leaves a mid to high layer cloud deck. The increased distance between the cloud base and the ground allows the air associated with a heat burst to have a longer distance to accelerate and warm. Secondly, the dying thunderstorm generates just enough precipitation to initiate the heat burst process but still preserves the dry layer beneath the storm. Both of these points are explained in more detail below.

The birth of a heat burst begins with precipitation falling out of the dying storm and evaporating in the dry air beneath the storm's base, producing a common phenomenon known as virga. The evaporation process cools the air in the immediate vicinity of the rain. Since this cooler air is denser than the surrounding air mass, this air "parcel" begins to sink. As it sinks, the parcel undergoes compression and warming as a result of the increased atmospheric pressure. At first, the parcel warms slowly (around 8°F per 1,000 feet) since the evaporation of water vapor offsets the compression induced warming. Once all of the water vapor is evaporated, the parcel warms at what is known as the dry adiabatic lapse rate, or just over 15°F per 1,000 feet.

As the parcel sinks towards the Earth, it accelerates and gains speed; thus, the higher in the atmosphere that the parcel originates (the base of the decaying storm), the greater the acceleration and downward momentum of the parcel. As long as the surrounding atmosphere is warmer than the air parcel, the parcel will continue to accelerate downward. For this to happen, the rate at which the atmospheric temperature must change (the lapse rate) will also need to be near dry adiabatic to match the rate at which the parcel is warming. Before the parcel reaches the Earth, it reaches its equilibrium level, or the point at which the air parcel temperature equals that of the surrounding air mass. From this point on, the parcel will be warmer than the surrounding air mass and want to rise. The parcel's motion carries it the remaining distance to the ground. Typically it requires a high degree of momentum to force the parcel all the way to the surface. Many developing heat bursts likely reach this point and quickly dissipate because their momentum cannot counteract the rising motion of the warm air.

The sounding diagram in Figure 2 using the original Omaha sounding helps to illustrate how a heat burst develops. In this plot, the pressure axis is oriented perpendicular to the surface and the temperature axis is oriented at a 45 degree angle to the

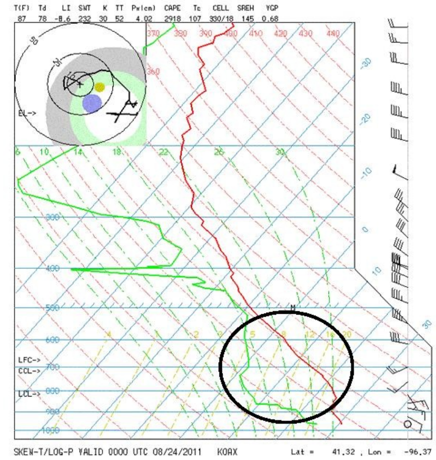

Figure 1: Sounding from Omaha, Nebraska at 7:00pm CDT on August 23, 2011.

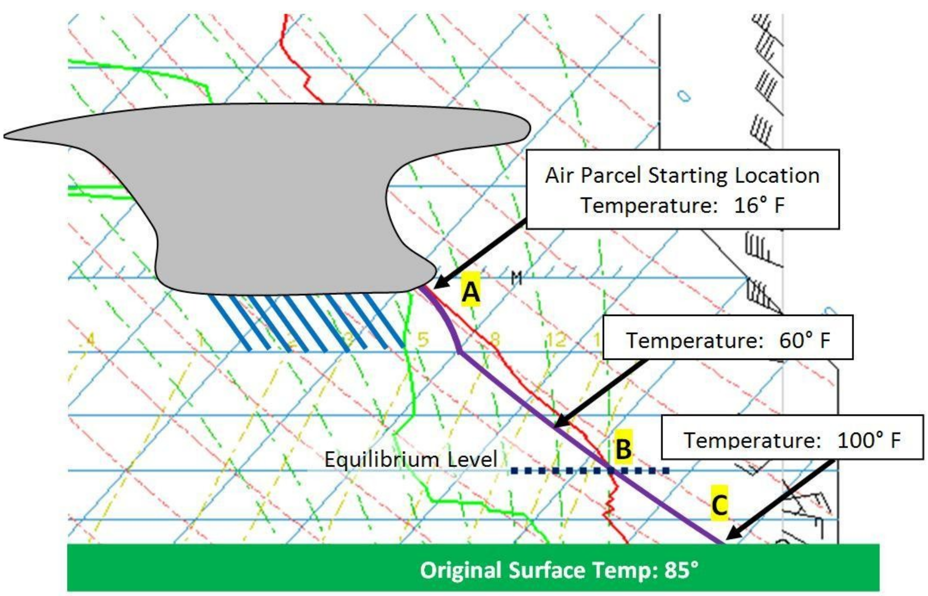

Figure 2: Diagram depicting the development of a heat burst.

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Heat Bursts

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ground. Originally, at Point A, the parcel and the surrounding air mass are the same temperature. However, as the rain from the dying storm evaporates, the parcel begins to cool and soon its temperature (purple line) is less than the surrounding air. The parcel continues to accelerate since it is cooler than the surrounding air until it reaches the equilibrium level (Point B). From this point forward, the air parcel will be warmer than the surrounding air mass and relies on its momentum to reach the surface (Point C). Model data for the evening of August 23 indicate that this sounding was reasonably representative of the conditions in southwest Iowa, with the equilibrium level possibly lower than indicated.The overall development process of a heat burst is very similar to a downburst from a mature thunderstorm. However, in the case of downbursts, the parcels originate closer to the ground and the heavy rainfall from the thunderstorm aids in accelerating the parcel more quickly to the Earth. The temperatures of downburst air parcels also tend to not exceed the ambient air temperature, allowing them reach the Earth at their full velocity.

The August 23 event originated with a series of disorganized showers and thunderstorms that formed over north central Nebraska during the morning hours on August 23 and tracked into Iowa during the mid afternoon and evening. Twenty-two observation sites (ASOS, AWOS, RWIS, and mesonet) in southwest/western Iowa and eastern Nebraska recorded heat burst signatures during the course of the afternoon and evening. A map of the sites in southwest Iowa is depicted in Figure 3, along with the maximum temperature reached (orange) and the overall change in temperature (yellow) during the event. While heat bursts have occurred in southwestern Iowa before, what made this event unique was its spatial and temporal extent. Typical heat burst events only affect a localized region for a short amount of time. The first site to record a heat burst on August 23 was the Tekamah, NE ASOS (near the Iowa/Nebraska border) at 3:50pm CDT and the Lamoni mesonet site recorded the last faint heat burst signature at 10:10pm CDT, over six hours and 140 miles away. Of the 22 observation sites, 14 recorded multiple heat bursts, sometimes hours apart. This aspect of the event also made it unique, since there are few, if any, documented cases involving multiple heat bursts from different cells over the same area.

It was difficult to ascertain whether the heat bursts travelled along any sort of continuous track with a particular cluster of cells, but in general, sites in western Iowa experienced heat bursts earlier in the day than those further south and east. Of these sites, the Atlantic AWOS (Figure 4) showed one of the most dramatic changes in temperature, jumping from a temperature of 86°F degrees at 6:45pm to 102°F at 7:25pm. In the meantime, the dew point plummeted to 7°F, but due to a known sensor problem with AWOS sites in western Iowa, the true dew point was likely between 40 and 50 degrees. The highest wind gust recorded was 41 mph.

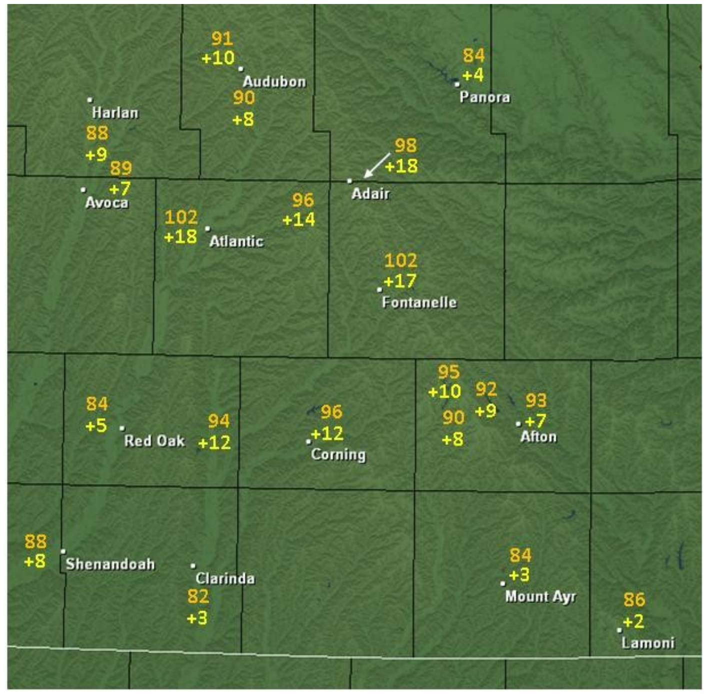

Figure 3: Map of the maximum temperature and overall change in temperature observed during the heat burst.

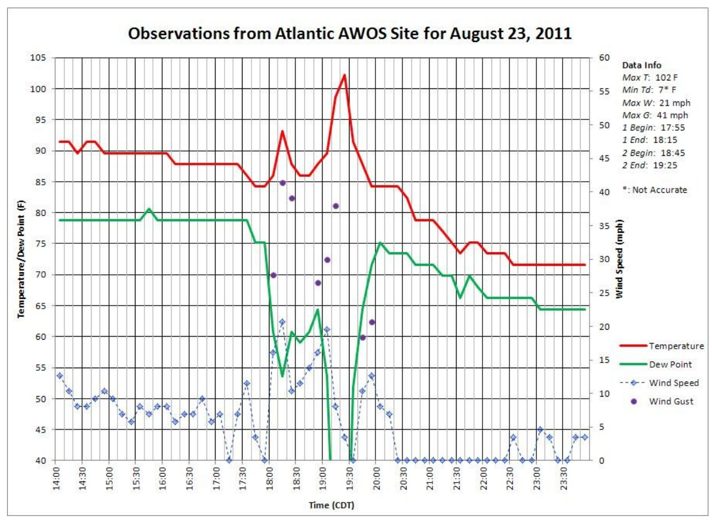

Figure 4: Temperature, dew point, and wind data from the Atlantic AWOS for August 23, 2011.

Further east, the Fontanelle mesonet site recorded the highest wind gust, hitting 60 mph at 7:44pm CDT.

Using velocity data from the Des Moines WSR-88D radar to locate the heat bursts yielded some interesting results. While most of the observed heat bursts did not have an associated velocity signature on radar, there were at least two instances that did have a correlated signature. The first occurred just north of Adair from 5:35pm to 5:55pm CDT, where radar data indicated a localized region of 50 to 60 mph winds at an altitude of 3,000 feet (Figure 5). Reflectivity data indicated a weakening cell in the same region, which likely produced the heat burst. The Adair RWIS site, despite being about five miles away from the radar signature, rec-

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Heat Bursts

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orded a three degree rise in temperature and a 15 degree drop in the dew point at the same time. The other instance of a correlated radar signature occurred around 7:00pm CDT in southern Audubon County, which was verified with a damage report at the same time.

Localized wind damage occurred across southwest Iowa with the passage of these heat bursts. The worst damage appears to have been just south of Brayton in southern Audubon County shortly after 7:00pm, where several reports of downed trees and power lines were received. Additional trees and power lines were reported down in the town of Bridgewater in Adair County at 6:50pm.

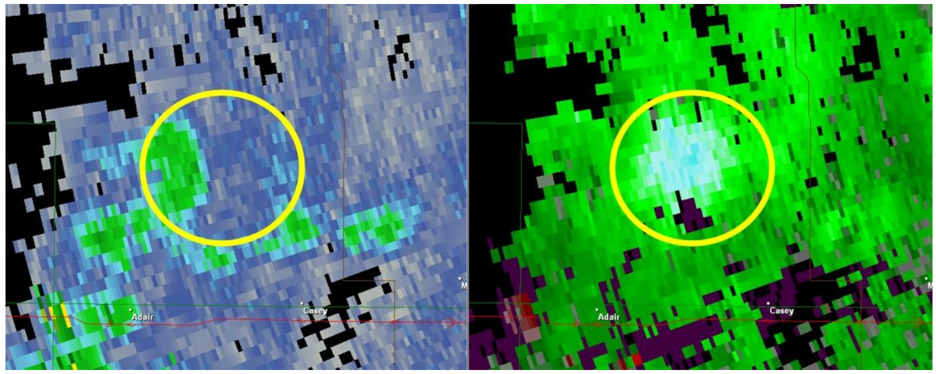

Figure 5: A split reflectivity (left) and velocity (right) radar image from the Des Moines WSR-88D radar at 5:46pm CDT just north of Adair in southwestern Guthrie County depicting a heat burst.

Fun Fact: The highest 24-hour total snowfall recoded at Des Moines occurred from December 31, 1941-January 1, 1942 when 19.8 inches of snow fell.

Winter Weather Awareness *by Aubry Bhattarai, General Forecaster*

Each year, exposure to cold, vehicle accidents caused by wintry roads, and fires caused by the improper use of heaters injure and kill hundreds of people in America. Add these to other winter weather hazards and you have a significant threat to human health and safety.

Winter storms can range from a moderate snow over a few hours to a blizzard with blinding, wind-driven snow that lasts for several days. Some winter storms are large enough to affect several states, while others affect only a single community.

What to listen for:

- **Winter Weather Advisory:** Accumulations of snow, freezing rain and/or sleet which, if caution is not exercised, could lead to life-threatening situations are expected.
- **Winter Storm Watch:** Winter storm conditions are possible in the next 12 to 48 hours.
- **Winter Storm Warning:** Issued when hazardous winter weather in the form of heavy snow, heavy freezing rain and/or heavy sleet is occurring or expected to occur within the next 36 hours.
- **Blizzard Watch:** Blizzard conditions are possible in the next 12 to 48 hours.
- **Blizzard Warning:** Combination of sustained wind or frequent gusts 35mph or greater and visibility less than ¼ mile in snow and/or blowing snow expected to last at least 3 hours. Expected to occur within the next 36 hours.
- **Wind Chill Advisory:** Wind chill values between -20°F and -29°F are expected to occur within the next 36 hours.
- **Wind Chill Watch:** Wind chill values of -30°F or lower are possible within the next 12 to 48 hours.
- **Wind Chill Warning:** Wind chill values of -30°F or lower are expected to occur within the next 36 hours.
- **Freezing Rain Advisory:** Accrual of less than ¼ inch of ice is expected due to freezing rain within the next 36 hours.
- **Ice Storm Warning:** Accrual of ¼ to one inch or more of ice is expected due to freezing rain within the next 36 hours.

Know before you go:

-Have your vehicle winterized before the winter storm season.
-Keep the gas tank full so you are ready in case of an emergency and to prevent the gas line from freezing.
-Take a fully charged cell phone or two-way radio with you.
-Plan to travel during the daylight and, if possible, take at least one other person with you.
-Let someone know your route and when you expect to arrive.
-Be sure to check the weather and road conditions before leaving.
-Avoid travel after a winter storm as roads may still be blocked or snow may still be blowing, reducing visibilities.

Weather Feature: Sun Dog

by Ken Podrazik, General Forecaster

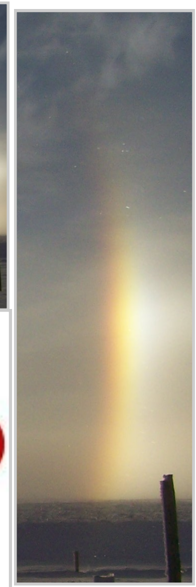

Figure 2 (bottom) and Figure 3 (top & right): The viewer is the blue line looking directly at the sun and the sun dogs are oriented on the same plane on either side of the sun. The 22 degree halo is barely present in the photo above, but you can notice how the two sun dogs begin to form a circle around the sun. Photo courtesy Mindy Beerends.

The photograph displayed on the front of the newsletter for the header is of a sun dog. It is also known as a Parhelia, Mock Sun, or a phantom sun. A sun dog is an atmospheric phenomenon due to the refraction of light through six-sided, or hexagonal, ice crystals. The sun light refracts or bends at an angle of 22 degrees around the sun. This is known as the 22 degree halo (Figure 1).

The 22 degree halo can be represented using an orange traffic cone and a straight pole through the center of the cone. The viewer (of the sun dog) would be looking through the orange cone at the small end or top hole, while the pole represents the line of site of the viewer looking directly at the sun. The 22 degree halo is represented by the surrounding orange cone. A sun dog is the section of the 22 degree halo horizontal with the sun, or at the same elevation as the sun (Figures 2 and 3). Sun dogs can occur at any time throughout the year, but are more common during the winter months as ice crystals are more prevalent.

The colors of the sun dog are formed when the sunlight is refracted by the ice crystals falling through the atmosphere. Most of the time it is due to cirrus clouds in the sky, but can also by due to blowing snow such as was the case from the blizzard of December 8-9, 2009 (click here for example). As these hexagonal ice crystals fall, they generally are oriented horizontally, or flat like a hamburger. As a result, the sunlight is refracted at a 22 degree angle through the horizontal ice crystals and forms the 22 degree halo as mentioned above (Figure 4). Sometimes the rest of the halo is not visible. Certain colors refract light at different angles through the ice crystals. These different refraction angles make up the color spectrum (Figure 5). The inner most color, the color closest to the sun, is red. Red bends, or refracts light at a slightly smaller angle than its counterparts on the opposite side of the spectrum. Mostly sun dogs consists of reds, oranges, and yellows. The blues and violets become less saturated or diluted with the color white. Another phenomena is a moon dog, which is formed the same way as a sun dog, and seen at night with the moon.

For more information on sun dogs, see the following links:

- ◊ http://hyperphysics.phy-astr.gsu.edu/hbase/atmos/halo22.html
- ◊ http://ww2010.atmos.uiuc.edu/%28Gh%29/guides/mtr/opt/ice/sd.rxml

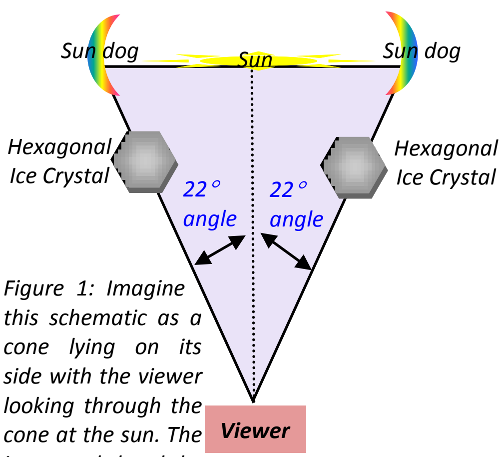

Figure 1: Imagine this schematic as a cone lying on its side with the viewer looking through the cone at the sun. The ice crystals bend the sunlight from the sun to form the sun dogs seen on each side of the sun.

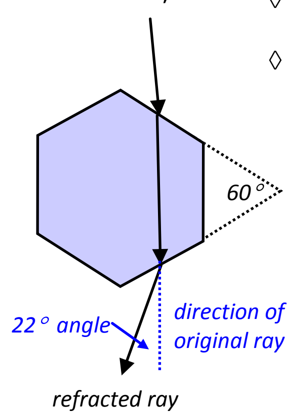

Figure 5: Ice crystals refract the sunlight at a 22 degree angle.

Figure 6: the acronym ROYGBIV—Red, Orange, Yellow, Green, Blue, Indigo, and Violet is used to represent the color spectrum.

Word Search Solution

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NWS Tours the 132nd Fighter Wing *by Ken Podrazik, General Forecaster*

Top: NWS Des Moines Tour Group in front of an F-16C in one of the Maintenance hangers. Bottom left: One of the weapons hangers. Bottom right: The tour group getting a sample of a pilot weather briefing.

In October 2011, several staff members from the National Weather Service (NWS) in Des Moines had a great opportunity to tour the 132nd Fighter Wing Iowa Air National Guard. The tour lasted nearly 4 hours and incorporated a visit to the aviation forecast office, flight briefing office, life support for pilots, flight line of the F-16C Fighting Falcon, the maintenance unit and weapons unit facilities, as well as a weather briefing to F-16C fighter pilots scheduled to fly that day. The tour ended with a visit and orientation of the Federal Aviation Administration (FAA) air traffic control center and the Des Moines International Airport tower. The tour group also had the privilege of witnessing the takeoff and landing the F-16C.

The base of the 132nd Fighter Wing is located on the Des Moines International Airport grounds and it maintains and flies the F-16C Fighting Falcon aircraft. The 132nd has flown the F-16C since 1992 and has flown 22 other type of aircraft since the unit originated in 1941. The 132nd Fighter Wing was originally founded as the 124th Observation Squadron before the 132nd Fighter Group combined with them to form the 132nd Fighter Wing after World War II. Since then, the Fighter Wing has supported the Korean Conflict, Desert Shield/Desert Storm, Enduring Freedom, and Iraqi Freedom. During the 1993 and 2008 record flooding events, the 132nd engaged in a major role with the flood recovery as it furnished personnel and logistics support to the relief operations throughout the Des Moines area.

132nd Fighter Wing F-16C on flight line

The group of NWS Des Moines meteorologists met with members of the 132nd Fighter Wing weather staff, pilots, and maintenance crew to discuss how weather impacts their operations and how the NWS products are used on a day-to-day basis. Aviation products such as the Terminal Aerodrome Forecast (TAF) and Aviation Discussion are used by the Fighter Wing during their pilot briefings. The 132nd is highly concerned with severe weather, winter weather, and high winds in order to protect the Guard members from getting injured and equipment from receiving damage. More information about the 132nd Fighter Wing Air National Guard can be found at the following link: http://www.132fw.ang.af.mil/ The NWS Des Moines office would like to thank the 132nd Fighter Wing staff for the opportunity to tour their facilities and learn about their day-to-day operations.

Fire Weather Update *By Frank Boksa, General Forecaster*

The fire weather season for 2011 will wrap up on November 15. That is the last day that the regularly scheduled Fire Weather Planning Forecast will be issued for the year. Requests for Spot Forecasts will be taken any time and should the need arise for a Rangeland Fire Danger product then those will be issued as well. Many thanks to the County Conservation volunteers that provide the National Weather Service with valuable data to help us provide accurate fire weather forecasts.

We had an interesting fire weather season. Conditions were wet in the spring then were very dry going into the harvest season. At the end of September through the first week of October, grassland curing values, as reported by County Conservation partners and by satellite data, indicated that field grasses were only about 30-40 percent cured while corn and soybeans were completely cured and ready for harvest. As harvesting progressed, we experienced several days where unusually warm temperatures and windy conditions posed a threat of crop fires during harvest. The Grassland Fire Danger Index, because grasses were only 30-40 percent cured, did not indicate a fire threat but on September 29 and October 5 and 6, reality proved differently. We at the National Weather Service will be studying how to better warn for these conditions without confusing people by adding numerous additional products to our suite of forecast products. Customers can be looking for improvements to the fire weather program next season as we address the crop fire issue.

As of October 27, the National Weather Service in Johnston, IA issued 129 Spot Forecasts, 2 Special Weather Statements on crop fire threats, and 9 Grassland Fire Danger Products (all in the spring). These were in addition to daily Fire Weather Planning Forecasts which ran from March 1.

Hurricanes in Iowa? Part 1 of 3 *by Aubry Bhattarai, General Forecaster*

As the 2011 Atlantic hurricane season winds down and with Hurricane Irene and Tropical Storm Lee making headlines throughout the season, perhaps some have begun to wonder if hurricanes could ever affect Iowa. With Des Moines lying over 800 miles from the Gulf of Mexico, it seems unlikely that a hurricane would be able to impact the state. However, throughout history a few storms have persisted and tracked very near, or across, Iowa. In upcoming editions of the newsletter, we will look at hurricanes which have impacted the state of Iowa.

1900 Galveston Strom

About August 27—September 12

The 1900 Galveston Hurricane is the deadliest natural disaster in U.S. history. The exact number of fatalities is not known, but it is estimated 6,000-8,000 people perished in Galveston. The storm first made U.S. landfall on September 8, it is difficult to determine how strong the storm was at landfall, as the anemometer at the weather office in Galveston blew away at 100mph, but it is generally accepted that the storm made landfall as a category 4 hurricane. Storm surge is estimated to have been 15-20 feet. The city of Galveston at the time had no protections from hurricanes (no sea wall) and much of the city was devastated by the storm.

Figure 1 shows the track of this storm. The storm remained a category 1 hurricane as it pushed inland across Texas, weakening to a tropical storm near Dallas. The tropical storm persisted as the system tracked north into Kansas. The system then curved northeast across Kansas and into Iowa.

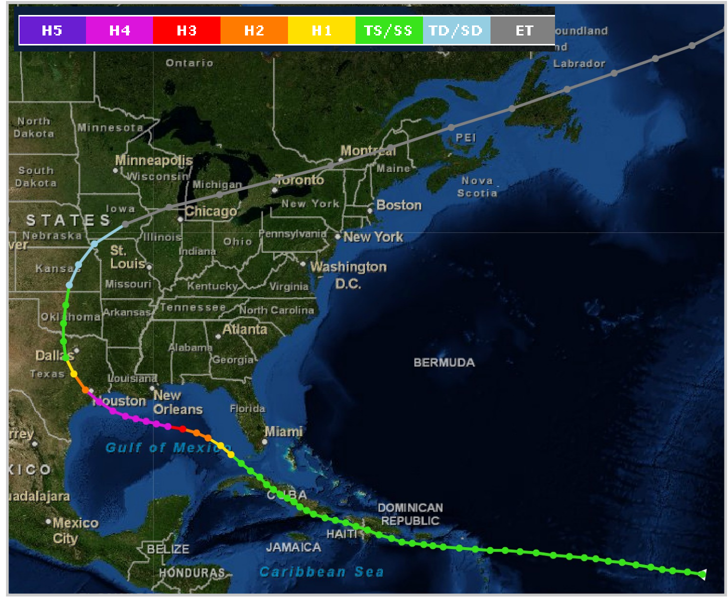

Figure 1: Reconstructed Track of the 1900 Galveston storm.

The system pushed into Iowa on September 11, 1900 and remained a tropical depression well into central Iowa before weakening later the same day. Des Moines reported 0.35 inches of rain on September 11, 1900. Locations to the north received rainfall from 1 to nearly 5 inches, with 4.60 inches of precipitation reported near Estherville, IA. Daily rainfall records for near Algona and Northwood were set in 1900 (with 2.15 and 1.88 inches respectively) and still remain unbroken. It is important to note that these sites are not official climate sites in Iowa, and the records may be incorrect due to errors in reporting, or incomplete data sets. By late in the day September 12, 1900, the extremely fast moving storm had pushed eastward, across Maine and into the Gulf of St. Lawrence, nearly 1,500 miles away from Iowa.

Climatological Data for July through September 2011

Location	Month	Average Temp	Departure	Highest	Lowest	Rain / Snow	Departure
Des Moines	Jul	81.6°F	+5.5°F	99°F (18th,20th)	13°F (4th,13th)	1.47” / 0.0”	-2.71” / NA
	Aug	76.3°F	+2.0°F	99°F (2nd, 3rd)	57°F (25th)	3.18” / 0.0”	-0.95” / NA
	Sep	64.1°F	-1.5°F	96°F (1st)	41°F (15th)	0.71” / 0.0”	-2.34” / NA
Mason City	Jul	75.8°F	+3.4°F	96°F (19th)	52°F (13th,25th)	2.12” / M	-2.22” / M
	Aug	70.6°F	+1.3°F	92°F (2nd)	47°F (29th)	0.83” / M	-3.21” / M
	Sep	59.0°F	-1.9°F	96°F (1st)	26°F (15th)	0.94” / M	-2.33” / M
Waterloo	Jul	77.6°F	+4.0°F	99°F (19th)	54°F (4th)	2.79” / 0.0”	-1.41” / NA
	Aug	71.5°F	+0.3°F	93°F (2nd)	49°F (11th)	3.21” / 0.0”	-1.06” / NA
	Sep	59.2°F	-3.8°F	93°F (1st)	31°F (15th)	2.66” / 0.0”	+0.03” / NA
Ottumwa	Jul	79.6°F	+2.9°F	98°F (20th,19th)	56°F (25th)	0.90” / M	-3.55” / M
	Aug	74.3°F	+1.3°F	57°F (2nd)	54°F (25th,30th)	2.12” / M	-2.49” / M
	Sep	61.4°F	-3.0°F	96°F (1st)	35°F (23rd,25th)	1.48” / M	-2.31” / M

Iowa Statewide Averages and Rankings for Temperature and Precipitation *by Craig Cogil, Senior Forecaster*

Month	Temperature	Departure from Normal	Rainfall	Departure from Normal	Temperature Ranking	Precipitation Ranking
June 2011	70.4°F	+0.6°F	6.25”	+1.61”	53^{rd} Warmest	27^{th} Wettest
July 2011	78.8°F	+5.7°F	3.37”	-0.88”	7^{th} Warmest	60^{th} Driest
August 2011	72.8°F	+1.5°F	3.02”	-1.16”	52^{nd} Warmest	49^{th} Driest
September 2011	60.6°F	-2.3°F	1.64”	-1.77”	21^{st} Coolest	18^{th} Driest
Summer 2011	74.0°F	+2.4°F	12.64”	-0.44”	18^{th} Warmest	60^{st} Wettest

Summer Months include June through August. Rankings are based upon 139 years of records. All values are preliminary.

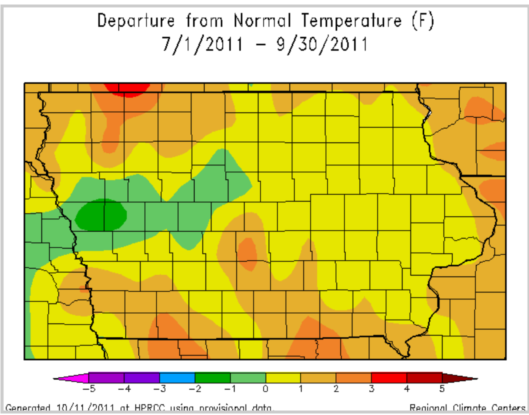

Figure 1: Departure from normal temperatures.

Temperatures:
Temperatures were above normal across the state during the summer with hot conditions being prevalent during the month of July (Figure 1). In fact, it was the seventh warmest July in 139 years of records. Overnight lows were particularly warm with readings remaining in the 70s for many nights across the state. There was some abatement in the heat by late August with September actually falling below normal for readings during the month. However, warmer than normal conditions returned for the month of October with many days reaching into the 70s and 80s across the state.

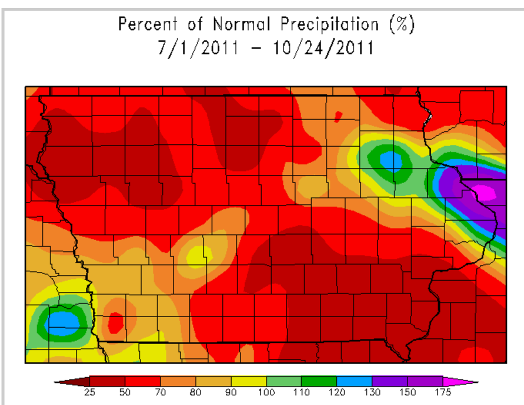

Figure 2: Departure from normal precipitation.

Precipitation:
Precipitation was widespread and quite generous during the month of June with active weather across much of the state. Above normal rainfall was observed in most locations to finish off a rather wet start to the warm season (Figure 2). However, the start of July saw a considerable drop off in precipitation across the state. This drier weather persisted for much of the latter half of the summer into the fall for much of Iowa. In fact, rainfall deficits in excess of 50% developed in portions of the state, mainly southeast Iowa as well as portions of north central and northwest Iowa. This had some impact on crops harvest with decreased yield in some of these areas. Drought conditions by late October had reached severe criteria in the southeast as well as portions of north central Iowa with much of the rest of the state with abnormally dry to moderate drought conditions. Little rainfall has occurred since the beginning of fall providing very little recharge to the soil.

2011 Cooperative Observer Length of Service Awards

by Brad Fillbach, Hydro-Meteorological Technician/Cooperative Program Manager

Randy Grossman of Denison, Iowa receives his 30 year Length of Service award. Brad Fillbach, HMT, WFO Des Moines presented the award. Randy also received the John Campanius Holm award in 2000.

Rod Truax of Parkersburg, Iowa receives a Certificate of Recognition for completing 5 years as a Cooperative Weather Observer. Award presented by Brad Fillbach, Hydro-Meteorological Technician, WFO Des Moines.

THE WEATHER WHISPER

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We want your feedback! Please let us know about your favorite stories and features, or if there is something you would like to see in an upcoming issue, feel free to contact the editors at: Kenneth.Podrazik@noaa.gov or Aubry.Bhattarai@noaa.gov